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Procedia - Social and Behavioral Sciences 46 (2012) 3722 – 3726

Procedia
Social and Behavioral Sciences

WCES-2012

Possibilities for identifying the contribution of strength and muscle power of of Track and Field sprint events

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Abstract

The purpose this research was to develop experiment and validate assessment and quantification tools of the global motivation and its three structural components: valence, expectancy and instrumentality in athletics, on formative stages. The infrastructural level of the motivation was calculated by determining the size of each of the motivation factors dimension and then the GMF and MI were calculated. The quantification was calculated by using indiscriminate responses obtained for the content and context factors. The results were appreciated on a motivational scale rated with three parameters: large, medium, small, elaborated based on he scores of the answers variants and the content of the formula for determining the GMF.

Key words: effectiveness, evaluation, performance, muscle strength, speed

1. **Background**

It is said that ”the strength that an athlete can apply and the speed which he applies it are mentained in a opposite relation”[Bompa T., 2003, p.272]. The starting power, the acceleration power and the strength resistence are considered the forms of manifestation of strength that determines the plenary manifestation of the effort capacity in sprint try outs [Bompa T., & Carrera M.C., 2006, p.120; Giakas, G., Koutsouki, D., Baltzopoulos, V., 2004] and of the performance at sprint tryouts in Track & Field [Dintiman G.B.,& Ward R.D., 1999; Tillinger, P., Kovar, K.,2004; Zaţiorski V.,2005, p 86-102; Grund M., 2006**;** Kuitunen S., 2010]. We found the gap between the performances value of world class and national level sprinters at all formative levels of training.

1. Purpose of study

Optimizing the performance in speed tryouts by monitoring the parameters of speed, strength and power as measured by „Quattro Jump Bosco Protocol Version 1.0.9.2”, on Kistler platform, Miron Georgescu tryout modified, tensiomyography (TMG) and electromyography.

2. Methods

The parameters data of speed, strength and power and power resistence being obtained in accordance with Bosco protocol, the Miron Georgescu tryout modified, tensiomyography (TMG) and electromyogrphy.

- *„Quattro Jump Bosco Protocol Version 1.0.9.2”,* on Kistler platform, measured parameters**:**
  hf – maximum height of mass center during flight
  hc – the lower value of mass center in squat
  Pavg – the average muscle power W/Kg
  Bilateral deficit % - when using both left and right
  Additional weight – equal with body weight
  Bosco indicator % = hf SJbw / hf SJ * 100% indicates the future training direction to strength or speed

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 doi:10.1016/j.sbspro.2012.06.134

FT (Fast Twitch fiber) % - estimate the percentage of fast fibers responsible for the release of FV (The algorithm was highlighted by Bosco based on hundreds of SJ-CMJ report records and muscle biopsies by age, sex, training type) 25% = average

Muscle elasticity – (Efect of prestretch) – the contribution of the muscle elasticity **hf** – the maximum height of mass center during flight

T contact – contact time

Length

Speed resistance indicator – the ability to develop maximum power over time – hf CJb / hf CJbref

Volunteer effort indicator – the maximum performance relation imposed on 5 jumps **Tiredness index – (hf)** – The comparison of the first 5 jumps and the last 5/h.

Tiredness index – (P avg)- The comparison of the first 5 jumps and the last 5 on P avg

- *The tryout MGM-15* represents a determination test of the elements defining of neuromotor qualities, energetic, and control, at a maxim effort of strength-speed, at a triple extension level.The whole tryout is about doing three series of fifteen jumps each (on both legs , the right foot and the left foot) an a special mat, with the condition that each jump must be at the same maximum height and a minimum time of contact with the ground. After each series the subject has a break of fifteen thirty seconds to rest**.**

This tryout tries to bring the general resources of energetic nature of an athlete, going from the idea that the inferior limps are used in any department of sports, and two legs jumps and one leg are natural moves. Because the effort chosen is not seen in this form in the exercises practiced in different branches of sports, it's removed the possibility of distorting the results by anterior skills of the athletes, and the effort put is considered as nonspecific If the effort should be specific, some athletes would benefit rule because of technical processes. After conducting the test results are dependent only on the basic qualities of the athletes.

Following parameters were determined energy:

PU - average unit power - providing data related to the orientation training in sports training conditional, information on the qualities of speed, force-measuring the strength reported in kg W / kg. The higher the better.

Flight H - average height of flights - mainly to provide information directed force (force-speed/force). The higher the better.

V. Rep. - Recurrence rate - provides information force-speed/force oriented. The quality is even better as the numerical value of the parameter is lower. It is one of the main forms of manifestation of speed. Highlights the speed of the succeeding excitation processes inhibition (nerve cells) and processes with the relaxation of contraction (in muscle). They represent some of the parameters resulting from the test parameters that we have considered useful to us in our approach. Besides mentioned above parameters are calculated and turn the power unit: **AUP**

- *Tensiomyography (TMG).* It is a measurement method for determining the contracted muscle properties. The muscle is stimulated with an electrical stimulus during 1ms or a chain of electrical stimulation. The measurements are performed in isometric conditions.The TMG signals are realised to determine the following parameters: the delay time, time of contraction, maintenance, relaxation and maximal.

Following parameters were determined byfunctional symmetry: 1) At the achilian tendon (GL/GM) ;2) At the patellar ligaments (VM/VL);3) At the knee joint (VL&VM/RF/BF); 4) At the ankle joint (TA/GM&GL)

- *Electromyography.* It is a technique which measures the electrical activity of the muscles.It is often used as a method of clinical investigation that complets the physical medical examination and provide additional information (for example can help to determine the causes of disease: neurogenic or myopathic). But, in the same time, it is a useful tool in research, in muscle physiology and pathophysiology study. By this method can be study the bioelectrical activity at the striated muscle level, at rest and contraction, both in normal and pathological conditions.

Findings and Results

The study was conducted on nine sprint runners, members of the Olympic Team, National and University Club Pitesti, seniors. Highlighting the values of indicators determined through research can be an effective informational support in monitoring the physical training for optimizing the specific strength of the sprinters. Were determined of the elements defining of neuromotor qualities, energetic, and control, at a maxim effort of strength-speed, at a triple extension level**.** The TMG signals are realised to determine the following parameters: the delay time, time of contraction, maintenance, relaxation and maximal.

We illustrated the results of research for a case study, subject 3.The results „Quattro Jump Bosco Protocol Version 1.0.9.2", on Kistler platform for caz study, for F, V, HF and P, are presented in figures 1-4.

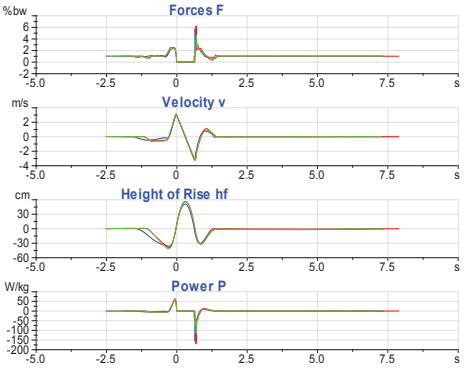

Fig. 1.Squat Jump (SJ)

Legend	Leg [cm]	hf [cm]	hc [W/kg]	Pavg
_____	1 Both	51.1	-36.1	28.3
_____	2 Both	56.5	-37.3	27.1
_____	3 Both	55.8	-39.0	24.5
Avg.		54.4	-37.5	26.6
Stdev		2.9	1.5	2.0

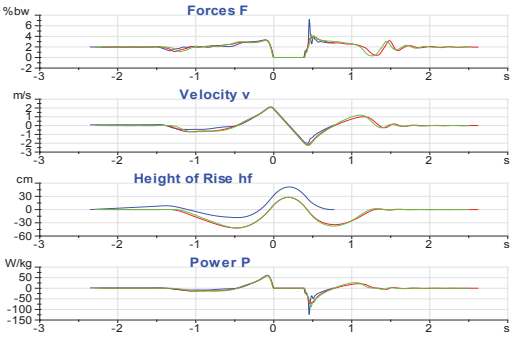

Fig. 2. Squat Jump with added Body Weight (SJbw)

Legend	Leg [cm]	hf [cm]	hc [W/kg]	Pavg
_____	1Both	51.3	-18.0	26.5
_____	2Both	27.7	-33.7	15.9
_____	3Both	27.8	-35,6	17.
Avg		35	-29.0	20.1
Stdev.		13.	9.5	5.6

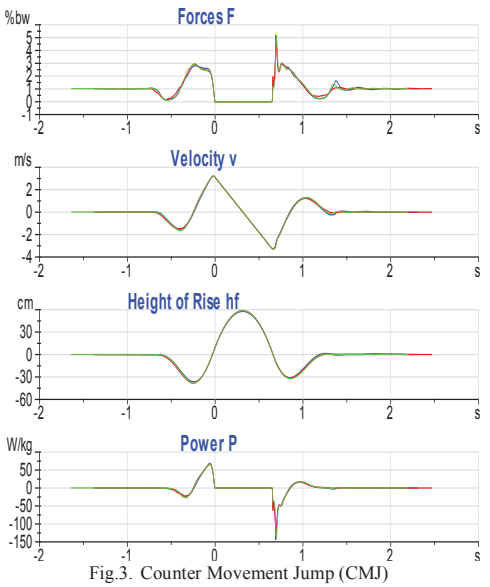

Fig.3. Counter Movement Jump (CMJ)

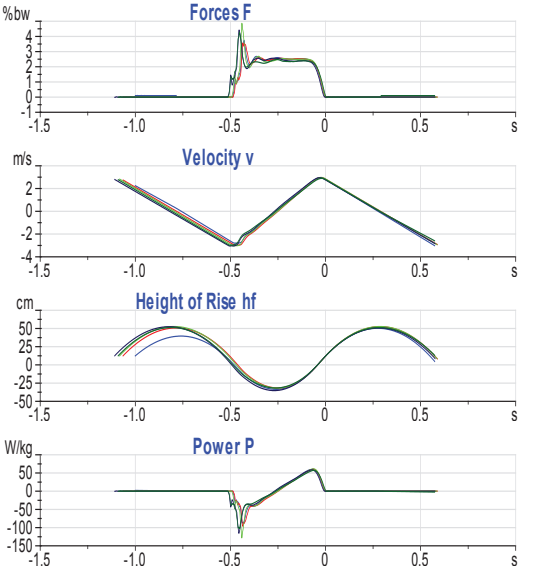

Fig.4. Continous Jump Bent Leg Reference (CJbref)

Bilateral Deficit (Pavg):n/a %
Fast Twitch Fibres (est.):51.9 %FT
Effect of Prestretch: 4.1 %
(reuse of elastic energy)

Legend	#	Leg	hf [cm]	hc [cm]	Pavg [W/kg]	Fi [BW]
_____	1	Both	57.7	-36.5	39.5	1.76
_____	2	Both	58.8	-38.2	39.4	1.90
_____	3	Both	58.6	-38.1	39.6	1.90
Avg.			58.3	-37.6	39.5	1.85
Stdev.			0.6	0.9	0.1	0.08

Legend	#	hf [cm]	hc [cm]	Pavg [W/kg]	Fi [%BW]
_____	1	50.2	-33.6	33.9	1.57
_____	2	52.4	-31.7	34.1	1.52
_____	3	52.7	-31.8	34.2	1.47
_____	4	50.7	-35.3	32.1	1.54
_____	5	51.3	-31.8	32.4	1.46
Avg.		51.4	-32.8	33.3	1.51
Stdev.		1.0	1.6	1.0	0.05

Table 1. The parameters level determined by MGM tryout at subject 3.

Statistical indicators	Processed rezults								
	Jumps both feet			Jumps on the right leg			Jumpings on the left leg		
	H	PU	PUA	H	PU	PUA	H	PU	PUA
	0.259	3.910	23.62	0.234	3.343	17.14	0.192	2.828	14.33
	0.360	5.298	42.53	0.234	3.433	18.47	0.254	3.474	16.94
	0.434	5.794	41.69	0.223	3.427	19.66	0.275	3.753	18.90
	0.463	5.986	41.60	0.259	3.673	19.36	0.208	3.117	16.63
	0.438	5.797	40.73	0.245	3.453	17.61	0.224	3.293	17.42
	0.354	5.053	34.95	0.237	3.380	17.33	0.252	3.619	19.28
	0.475	6.087	42.44	0.260	3.492	16.68	0.254	3.538	17.82
	0.366	5.141	35.07	0.242	3.467	18.03	0.270	3.665	18.08
	0.394	5.516	41.50	0.230	3.371	17.88	0.245	3.815	23.96
	0.364	5.185	37.12	0.242	3.432	17.53	0.240	3.436	17.81
	0.415	5.476	35.24	0.246	3.826	24.01	0.195	3.059	17.24
				0.279	3.785	19.02	0.144	2.415	13.84
	0.444	5.899	43.10	0.265	3.753	20.00	0.259	3.810	21.69
	0.411	5.601	40.28	0.160	2.563	14.03	0.196	2.894	14.80
	0.482	6.055	39.94	0.237	3.424	17.98	0.264	3.622	18.13
Max	0.482	6.087	43.10	0.279	3.826	24.01	0.275	3.815	23.96
Min	0.259	3.910	23.62	0.160	2.563	14.03	0.144	2.415	13.84
X	0.40	5.48	38.5	0.23	3.45	18.3	0.23	3.35	17.7
S.	0.06	0.57	5.19	0.02	0.29	2.13	0.03	0.41	2.61
Cv%	14.8	10.3	13.4	11.0	8.50	11.6	16.0	12.3	14.7

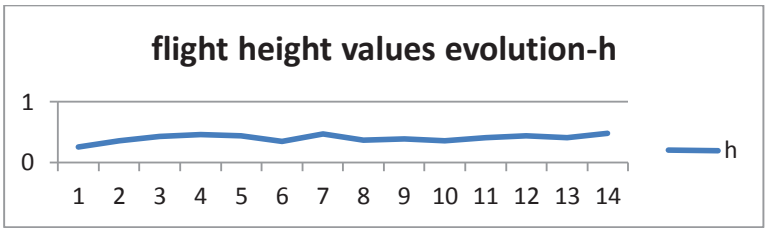

Fig. 5. Evolution values chart of the flight height during 15 jumps on both legs

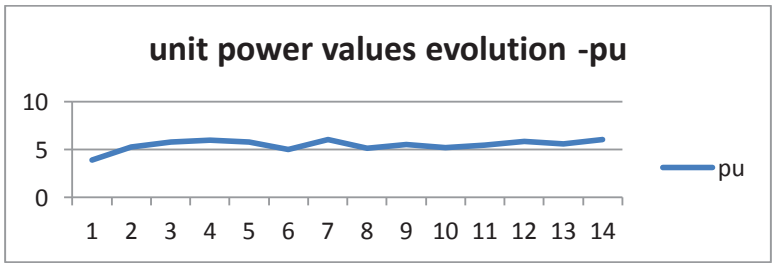

Fig.6. Evolution values chart of the unit power during 15 jumps on both legs

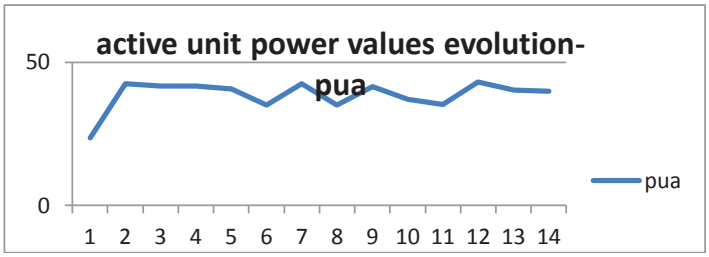

Fig.7. Evolution values chart of the active unit power during 15 jumps on both legs

The determinations with Tensiomyography (TMG) revealed the following values of functional symmetry: at the achilian tendon (GL/GM): right 92%, left: 84% ; at the patellar ligaments (VM/VL): right 80%, left 98%; at the knee joint (VL&VM/RF/BF): right: 82% left: 94%; at the ankle joint (TA/GM&GL):right 82%, left 99%

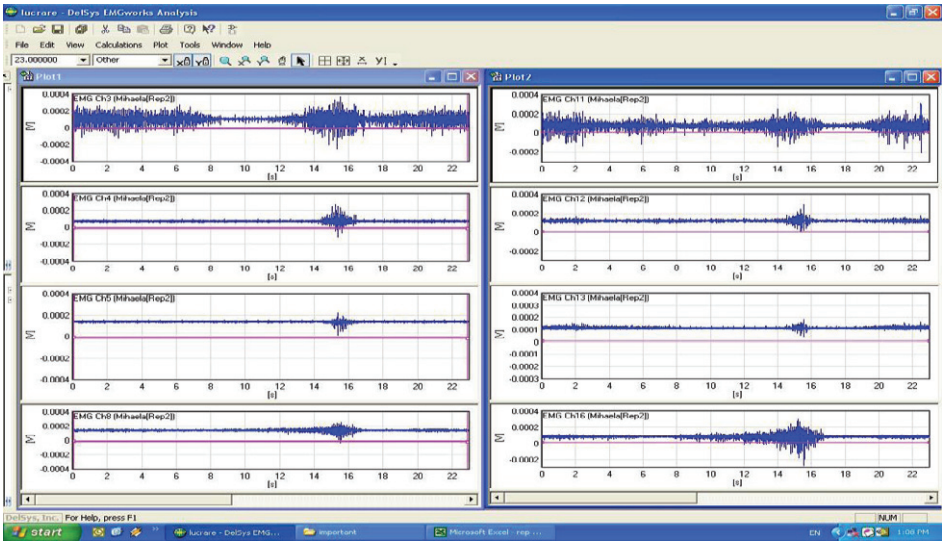

Fig. 8. EMG raw signals

Conclusions

Working hypothesis that optimizing the performance in speed tryouts by monitoring the parameters of speed, strength and power as measured by „Quattro Jump Bosco Protocol Version 1.0.9.2", on Kistler platform, Miron Georgescu tryout modified, tensiomyography (TMG) and electromyography, has been validated by research.

Research has revealed the direct relation between speed, strength and power level determined by the Bosco Protocol and the athletes ability of starting at base determined by the speed in the 20m race.

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